

to spend on furthering higher agricultural education, has decided that research is outside its purview.

Yet if there is one field of work of proved public utility which wants the fostering of a central authority it is agricultural research. To begin with, when it is only possible to raise one crop in a year the progress of an agricultural investigation is necessarily slow, and requires to be continued without any external pressure to produce a result quickly. Again, the problems of the nutrition of plant or animal are so complex that the investigator, eliminating variables to obtain a crucial test on some particular point, appears altogether unpractical to the farmer. Now that the main principles of the action of manures and their adaptation to particular crops and soils are known, original investigation, which is really breaking new ground, will not appeal either by its methods or even by its results to the ordinary man. It will be done for the benefit of the teacher and the expert, and will get translated into practice by modifying the instruction or advice which they give to the actual working farmer. But research of this kind will never obtain the support of the county councils, except so far as it is undertaken out of pure keenness by individuals on the staff of the various teaching institutions; the county councils require demonstrations of the application of known principles to local conditions and experiments for the enlightenment of the current generation of farmers. Even with such trials it is difficult to secure the necessary continuity of policy; Somerset has just discontinued its experimental farm after a very few years' trial, and there is a local movement directed against another county experimental farm which is very ominous in view of the pressure on educational funds brought about by the new Bill. For permanent investigations, "*travaux à longue haleine*," we have in this country only Rothamsted and the Royal Agricultural Society's station at Woburn; Rothamsted has but 2500*l.* a year (each American State gets at least 4000*l.* a year for its experiment station!), and is asking for further funds to enable it to do more than continue to exist, yet it does not appear to have convinced the Board of Agriculture that research is part of education or is worthy of assistance. As to the Woburn farm, who can say what will happen through the financial straits into which the society has been driven by its show at Park Royal? But in any case compare these two solitary agencies with the great organisation possessed by the United States, of which we get a personal impression in Prof. Armstrong's paper in the Mosely Commission reports. Yet it cannot be argued that we need such work any less than America, for even if in England itself "agriculture only stands for shillings where commerce stands for pounds," the proportion is very different when we look at the Empire as a whole. Teachers and investigators are being constantly called for; how are the experts to be trained, the teachers to be inspired, if there is no adequate provision for research at home? Up and down our dependencies men may be found doing expert work in agriculture, men whose knowledge, both of agriculture and of science, has been acquired by working as assistants in commercial analytical laboratories; these men are doing excellent work, but they cannot wholly escape from the defects of their training.

Nobody familiar with the facts can fail to recognise the enormous advance that has been made within the last twelve years, before which time agricultural education did not exist for the ordinary farmer; now it is good "in parts," and the time is ripe for a strong central administration to take the work in hand, level up all round, and put research, which should be the mainspring of the whole, on a sound independent footing.

NO. 1813, VOL. 70]

## TWO BOOKS ON LOCAL NATURAL HISTORY.<sup>1</sup>

MR. TREGARTHEN'S brightly written and exquisitely illustrated book is absolutely redolent of the breezy uplands and the surf-beaten beetling cliffs of the western duchy, and is evidently the work of a sportsman-naturalist of the old-fashioned and best type. It is true that the author deals with his subject more from the sporting than from the natural history aspect—and to a great extent with the methods of sport belonging to a bygone day—but perhaps it is none the worse for this, being entirely free from all traces of that "faddism" which tends to taint the work of many of the self-styled field-naturalists of to-day. Whether he is describing fox-hunting in the olden time, the habits and wiles of foxes and their cubs, dilating on the fascinations of digging out badgers from their subterranean retreats, or narrating the perils attendant on a midnight descent through a tortuous adit to the rocky cave where dwell the seals, he is equally delightful and fresh. All the photographs of animal life, to say nothing of those which portray the striking coast scenery of the Land's End district, are admirably well chosen and well executed, the one of fox cubs herewith reproduced being only a sample of the general excellence of style.

Although ostensibly devoted to sport, the work contains here and there some interesting observations with regard to the fauna of the county. We are told, for instance (p. 165), that hares are almost non-existent in this part of the country, their scarcity being due apparently not to excessive persecution, but to the unsuitableness of the climatic or other physical conditions. Some years ago, upwards of 150 of these animals were turned out in various parts with the result that within a comparatively short period nearly all had disappeared. It is satisfactory, however, to learn that the badger (why will the author call it one of the most ancient of animals?) is as abundant as the hare is scarce, the author stating that it generally shares a burrow with the fox. Seals, too, thanks to their wariness and the almost inaccessible caves they select for their abode, show no signs of decrease on the northern coast.

To the naturalist, the description of the seal-caves and their living denizens is, indeed, the cream of the whole book, and many readers would, we feel sure, long for an opportunity of beholding the scene described, were it not for the attendant dangers and difficulties. The particular visit described was made by night at low-water, when the entrance to the cave was barred by exposed boulders, thus rendering it impossible for the seals to escape. "We advanced to the edge of the water," writes the narrator when describing the visit, "with a torch in each hand, holding them well up, and forward at full arm's-length. It was the sight of a lifetime. Five huge beasts, two grey, the rest a dirty yellow, mottled with black spots, lay swaying on the sand, prepared to make a rush—they can shuffle down a slope at a great pace—if we entered the pool; and these were not all, for in dark recesses beyond I saw indistinct forms move, and once I thought I caught the gleam of liquid eyes."

The numerous species of sea and shore birds frequenting the Land's End claim the author's attention in the concluding chapter, where reference is also made to several of the rarer birds of the land. Both

<sup>1</sup> "Wild Life at the Land's End; Observations of the Habits and Haunt of the Fox, Badger, Otter, Seal, Hare, and of their Pursuers in Cornwall." By J. C. Tregarthen. Pp. xii+236; illustrated. (London: John Murray, 1904.) Price 10s. 6*d.* net.

"In the King's County." By E. K. Robinson. Pp. viii+352. (London: Isbister and Co., 1904.) Price 6s.

magpies and green woodpeckers are stated to be more common at the present day than was formerly the case, while it is only of late years that the pushing starling has taken to breed in the district. With a bare reference to the account of the author's last sight of a pair of Cornish choughs—possibly the last of their kind—we must take leave of a charming volume.

In any work devoted to outdoor life in Norfolk the element of sport is certain to loom large, next to which birds will probably claim a considerable share of the author's attention, and Mr. Robinson's volume is no exception to this rule. Such subjects as "a royal shoot" and "beside the covert" are, indeed, intercalated with chapters on "panics in bird-land," "the hawk's harvest," and the "birds of autumn," and throughout the portions devoted to the wild life of the county there will be found scattered many observations

#### RELATION OF RAINFALL TO RUN OFF.

IN NATURE of January 7 (vol. lxi. p. 226) notice was directed to the attention paid by the Geological Department of the United States to the water resources of the country, and to the series of reports that had been issued relating to the supply available for domestic and business purposes, for power and for irrigation. We have recently received a further series of reports relating to the progress of the stream measurements for the year 1902 carried out on the northern and southern Atlantic coasts, Mississippi River, Great Lakes, Pacific coast and Hudson Bay drainage districts; the hydrography of California and the storage reservoir there; and an account of the irrigation of India.

With the exception of the last, these volumes consist almost entirely of statistical records of the flow

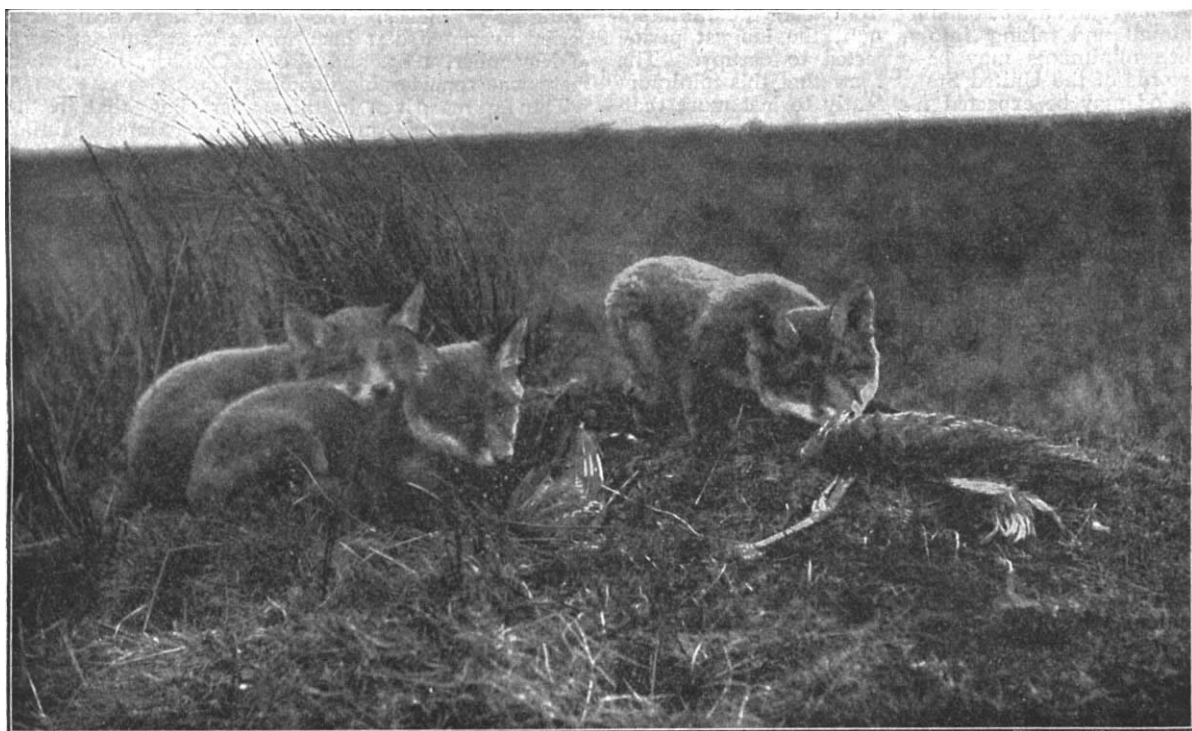


FIG. 1.—Fox cubs. From Tregarthen's "Wild Life at the Land's End."

From a Photograph by C. Reid.

which cannot fail to be of interest to the field-naturalist and lover of the country. A feature of the work is the candid and straightforward manner in which the utility or harmfulness of the mammals and birds generally classed by keepers as "vermin" are discussed, no special pleading being used to afford any of these creatures exemption from destruction when, in the author's opinion, it is well merited. Among the mammals which, according to Mr. Robinson, rightly occupy a place in the "keeper's museum" are the stoat and the hedgehog, the indictment against the latter, from the keeper's point of view, being even heavier than the one in Bell's "British Quadrupeds."

To residents in Norfolk the book should prove specially welcome, but it is also one which can be taken up to while away an idle hour by every reader interested in sport and country life.

R. L.

NO. 1813, VOL. 70]

of streams, and although of great value to American hydrologists, do not call for any special notice.

Paper No. 80 of the series of hydrographic investigations on the relation of rainfall to run off, compiled by Mr. George W. Rafter, contains information which is of value to those interested generally in the question of water supply.

The author of the paper commences by saying that, as the result of many years' study of the problem indicated by the title of the paper, he has come to the conclusion that no general formula is likely to be found expressing accurately the relation of rainfall to the run off of streams, for these vary so widely in their behaviour that every stream is a law unto itself.

Mr. Rafter directs attention to the desirability of the adoption of uniformity or standardisation of the units of measurement, and warns engineers to be very slow to add to the number of standards of measure